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Defective guardrails in serious-injury and death cases

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A guardrail is intended to reduce the potential for and severity of accidents involving vehicles that run off the roadway. However, the guardrail itself is a hazard — especially the exposed or blunt end of the guardrail installation, which is capable of spearing errant vehicles that are unlucky enough to hit the end of the guardrail.

Road crews addressed this problem by burying the ends of some guardrails. This approach, however, inadvertently created ramps that caused vehicle rollovers.

In 1989, Texas A&M Transportation Institute, or TTI, designed the ET-2000, an energy-absorbing terminal that was installed on the end of guardrail systems.

> Developing a highway safety device is generally a long and arduous process.

When an errant vehicle left the roadway and struck the end of the guardrail, the ET-2000 end terminal acted as a buffer that absorbed energy as it pressed into the rail behind it — forcing the W-shaped guardrail through a slot in the side of the end terminal, which flattened the guardrail into a ribbon of steel away from the car.

Following extensive testing, the Federal Highway Administration, or FHWA, approved the ET-2000 end terminal system for installation on the national highway system.

To manufacture and sell the ET-2000, TTI entered into a licensing agreement with Syro Steel Co. In the early 1990s, Trinity Industries purchased Syro Steel along with the rights to manufacture and sell the ET-2000.

Trinity redesigned the system in 2000, creating a lighter and cheaper version that it named the ET-Plus. But poor design, a lack of testing and secret design changes led to deadly consequences, and this model has become the subject of product defect lawsuits nationwide.

WHY THE ET-PLUS FAILS

The American Association of State Highway and Transportation Officials' Roadside Design Guide states: "To be crashworthy, an end treatment must not spear, vault, or roll a vehicle for head-on or angled impacts. A vehicle must be safely stopped or redirected by the end treatment when impacted end-on."

Despite this directive, there are several models of guardrail end terminals on the market today — including the ET-Plus and another called the X-Lite — that have serious design defects, which can result in horrible injuries and fatalities to the occupants of errant vehicles in off-the-roadway accidents.

In September 2015 the FHWA published a task force report on guardrail end terminals and "identified several performance limitations for all types of extruding W-beam guardrail terminals."

The FHWA determined that the crash-testing guidelines fail to address these performance limitations.

The ET-Plus guardrail system routinely malfunctions when struck by oncoming traffic. Instead of ribboning out and absorbing the impact as designed, the extrusion forces inside the ET-Plus head cause the guardrail to lock up, which buckles the guardrail.

The impacting vehicle will rotate clockwise and subject the driver to the exposed end of the guardrail. Many times, vehicles are simply impaled, causing serious and fatal injuries to the occupants.

TRINITY'S UNNECESSARY AND DANGEROUS REDESIGN

On Jan. 9, 1996, Trinity employee Steve Easton published an in-service evaluation of the ET-2000. Based on crash data from Texas and Ohio, Easton determined the injury severity level of the ET-2000 to be very low, comparable to air bag systems.

Easton reported "no performance problems" with the system. The FHWA also noted that the ET-2000 had an "excellent history."

Despite this proven record of safety and crashworthiness, in the late 1990s Trinity started pushing unnecessary — and dangerous — design modifications to the ET-2000 system.

Steve Brown, a senior Trinity executive, contacted the engineers at TTI and requested a meeting to discuss modifying the ET-2000. According to Brown, Trinity was motivated to redesign the system because of its aging patent.

In other words, Trinity was not trying to improve its product but was instead attempting to design an end terminal that would receive new patent protection from generic competition.

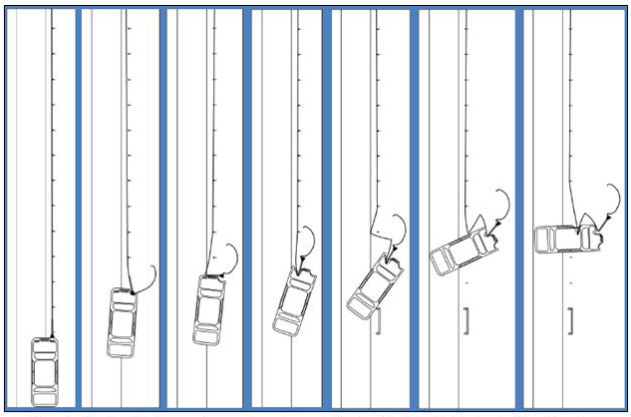


Figure 7 – Head-on/shallow-angle corner impact scenario, Safety Analysis of Extruding W-Beam Guardrail Terminal Crashes, Report from Joint AASHTO-FHWA Task Force on Guardrail Terminal Crash Analysis

It is universally known in the highway safety community that developing a highway safety device is generally a long and arduous process.

However, in the case of the ET-Plus, Brown and several TTI engineers redesigned the ET-2000 end terminal during a single meeting that lasted no more than a few hours. These individuals made ad hoc design changes without the benefit of any engineering analysis, design calculations or computer simulations.

Trinity's design methodology — or what little can be gleaned from it — is so nebulous and lacking in scientific rigor as to cast serious doubt on whether any engineering judgment was exercised in the design of the ET-Plus.

In fact, following the design meeting, Trinity selected Wade Malizia — a plant manager with no engineering experience or background — to construct the prototype.

Malizia holds a bachelor's degree in business from Youngstown State University. He was given no design or fabrication drawings. Instead, he was only given Brown's meeting notes.

> The company simply decided to ignore critical steps in the development of the system.

Despite its renowned safety record, Trinity effectively trashed the ET-2000 end terminal by making dramatic modifications.

In particular, Trinity removed roughly 100 pounds of steel from the end terminal by reducing the number of internal stiffeners and narrowing the impact faceplate. It also reduced the end terminal's overall length and shortened the extruder section of the head.

Most importantly, the changes produced an asymmetrical head design. This asymmetry increased rotation during the extrusion process, which substantially increased the potential for lockup and exposure of the vehicle to the guardrail's blunt end.

TRINITY'S LACK OF ADEQUATE CRASH TESTING

In May 1993, a group of engineers with TTI published a set of crash-testing guidelines for the Transportation Research Board titled "The National Cooperative Highway Research Program Report 350, Recommended Procedures for the Safety Performance Evaluation of Highway Features."

According to the report, "The purpose of this report is to present uniform guidelines for the crash testing of both permanent and temporary highway safety features and recommended evaluation criteria to assess test results."

NCHRP Report 350 is not a federal regulation or standard. Rather, the FHWA "adopted" NCHRP Report 350 by reference in the "Guides and References" Section of the Non-Regulatory Supplement to the Federal-Aid Policy Guide.

In other words, there is no federal safety standard for guardrail end terminals. Instead, the FHWA controls the purse strings and will only allow end terminals that meet the testing criteria of NCHRP Report 350 to be installed on federal highway projects.

NCHRP Report 350 contains seven recommended tests for any new or significantly modified guardrail end terminal. Rather than conduct the seven different crash tests, Trinity conducted a single crash test of the new ET-Plus extruder head Oct. 5, 1999. Despite its financial interest and apparent conflict of interest in the outcome of the testing, TTI conducted and evaluated the test.

Predictably, TTI determined that the ET-Plus successfully completed the crash test in accordance with NCHRP 350 requirements.

Two months later, Trinity submitted its single crash test report for the ET-Plus with a 5-inch end terminal, identifying six design changes from the ET-2000 and seeking approval for federal reimbursement.

Following approval from the FHWA, Trinity started marketing its new and "improved" ET-Plus system. Due to Trinity's aggressive marketing and sales force, the ET-Plus quickly became one of the most installed end terminals in the United States.

TRINITY'S FAILURE TO CONDUCT IN-SERVICE PERFORMANCE EVALUATION

According to Easton — the Trinity employee and author of In-Service Evaluation of the ET-2000 Guardrail End Treatment — "the most significant method (more telling than crash testing) for evaluating a safety hardware device is its in-service performance."

NCHRP 350 specifically states that the crash tests are not meant to be "all-inclusive." It adds, "In-service evaluation is used in the final stage of development of new or extensively modified roadside safety features and has the purpose of

appraising actual performance during a broad range of collision, environmental, operational and maintenance situations for typical site and traffic conditions."

In fact, NCHRP Report 350 clearly states: "Good performance under ideal test conditions does not ensure comparable performance under in-service conditions. As discussed in Chapter 1, the evaluation process should not stop with successful completion of tests recommended herein. In-service evaluation of the feature is perhaps more important than crash test evaluation and should be pursued as recommended in Chapter 7."

The FHWA directly informed Trinity of this requirement during the approval process for the ET-Plus.

But during the nearly two decades that Trinity marketed and sold the ET-Plus, it admittedly failed to conduct a single in-service performance evaluation of the system.

In fact, despite conducting an in-service evaluation on the ET-2000, Trinity Highway Product's president, Gregg Mitchell, testified during the approval hearings that the Trinity defendants "have not been successful in ... achieving a formalized process by which in-service evaluation information could be obtained."

It is clear that Trinity simply decided to ignore this critical step in the development of the ET-Plus.

On Nov. 4, 2014, Malcolm Ray — Trinity's longtime design expert — sent a letter to Gregory Nadeau, the acting administrator of the FHWA. In this letter, Ray admitted he had "little understanding" of how end terminals perform in the field.

He said the roadside community lacks "real data" on the performance of end terminals and that then-current performance determinations were based on "guess work and speculation."

Ray's letter closed as follows:

I do not know what the results of an in-service evaluation of guardrail terminals might ultimately reveal. I suspect that the ET-PLUS performs as well as any of the other similar guardrail terminals available but is it not time to find out what the real truth is? I urge you to direct the States to perform comprehensive in-service studies on all of their guardrail terminals in accordance with the study protocol documented in NCHRP Report 490. I urge the FHWA to take a pro-active role in ensuring that the necessary data are collected to support these important decisions. These studies must be based on crash data, maintenance records, roadside inventories and traffic data. It is time to start basing roadside safety policy on real data rather than guess work and speculation and I am hopeful that the FHWA would take the lead in such an endeavor.

Sincerely,

Malcolm H. Ray, P.E., Ph.D.

Cc: Mr. Jeffery Paniati, FHWA
Mr. Tony Furst, FHWA
Mr. Micheal Griffith, FHWA
Mr. Nicholas Artimovich, FHWA

Trinity's Undisclosed Modifications to the ET-Plus End Terminal System

In November 2004, Trinity executive Steve Brown emailed his superiors pushing modifications to the ET-Plus.

In particular, Brown suggested the guide channel, or C-channel, on the end terminal could be reduced by an inch, saving $2 per end terminal. Brown — who was not an engineer — stated that if TTI agreed to this modification then Trinity could make the change with "no announcement."

Trinity was again pushing a design modification without conducting a proper engineering analysis or in-service evaluation to determine what the real-world impact of the change would be.

In fact, Brown knew the only analysis Trinity conducted before implementing design changes into the system was informal "piece of paper" calculations to determine the difference in weight and cost.

He wildly speculated that modifying the guide channel would "in some ways offer ... some benefits" in certain crashes. It is undisputable that Brown's justification was pure speculation.

These statements, by a non-engineer, were an attempt to justify modifications that would save Trinity $2 per end terminal. Without any input from the engineers at TTI, Trinity assigned Malizia to design and fabricate a prototype 4-inch ET-Plus to replace the 5-inch.

According to the deposition of Malizia, unidentified shop workers fabricated the prototype 4-inch ET-Plus. They did so without input or guidance from an engineer. They conducted no engineering or failure mode analysis. They changed the end terminal's welds between the guide channel and end terminal from butt welds to fillet welds. This was done without analyzing the weld strength.

The reduced guide channel required insertion into the end terminal, which reduced the internal height of the squeezer section and reduced the overall length of the end terminal.

Again, none of these design changes were subjected to any engineering analysis or calculations.

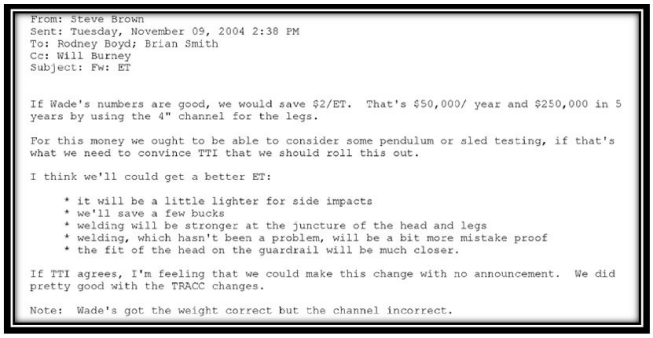
Trinity and TTI conducted a single crash test with the 4-inch ET-Plus prototype May 27, 2005. Despite its financial interest in the outcome of the crash test, TTI conducted the test and evaluated the results.

The crash test report, prepared by TTI and submitted by Trinity, contained no mention of the above-referenced design modifications. Rather, Trinity referred to the 4-inch ET-Plus as a "standard" end terminal.

The submission also lacked any detailed drawings or photographs of the end terminal. The FHWA approval letter highlighted seven design modifications, none of which mentioned the change to a 4-inch guide channel.

TRINITY'S FAILED FLARED 4-INCH ET-PLUS CRASH TESTING

Guardrail systems are considered "flared" when they are not parallel to the edge of the roadway. In an effort to increase the marketability of the ET-Plus, Trinity developed and crash-tested the ET-Plus end terminal system that was flared four feet from the roadway. Trinity called this the "Flared ET-Plus System."



From: Steve Brown
Sent: Tuesday, November 09, 2004 2:38 PM
To: Rodney Boyd; Brian Smith
Cc: Will Burney
Subject: Fw: ET

If Wade's numbers are good, we would save $2/ET. That's $50,000/ year and $250,000 in 5 years by using the 4" channel for the legs.

For this money we ought to be able to consider some pendulum or sled testing, if that's what we need to convince TTI that we should roll this out.

I think we'll could get a better ET:

* it will be a little lighter for side impacts
* we'll save a few bucks
* welding will be stronger at the juncture of the head and legs
* welding, which hasn't been a problem, will be a bit more mistake proof
* the fit of the head on the guardrail will be much closer.

If TTI agrees, I'm feeling that we could make this change with no announcement. We did pretty good with the TRACC changes.

Note: Wade's got the weight correct but the channel incorrect.

The system was intended to function in substantially the same manner as the normal ET-Plus System, and it included the ET-Plus extruder head.

On Sept. 17, 2001, Trinity conducted its first crash test of the Flared ET-Plus System. The test included the original 5-inch ET-Plus extruder head. Almost immediately upon impact, the extruder head locked up, the guardrail buckled, the vehicle rotated clockwise, and the W-beam penetrated the driver's side occupant compartment.

This test was deemed a failure.

Following the initial failed Flared ET-Plus crash test, Trinity started running computer simulations and conducting pendulum testing in preparation for the next full-scale crash tests. In June 2005 it conducted its second crash test on the Flared ET-Plus System. This was the first of five flared crash tests that included the 4-inch ET-Plus extruder head.

The results were nearly identical to the previous crash test — there was lockup, buckling, clockwise vehicle rotation, and W-beam guardrail penetration of the driver's side occupant compartment.

Over the next six months, Trinity conducted four additional crash tests of the Flared ET-Plus System. Each time, the 4-inch ET-Plus extruder head buckled and the guardrail pierced the test vehicle, resulting in driver's side penetration or rollover.

By March 2006, Trinity had abandoned the Flared ET-Plus system.

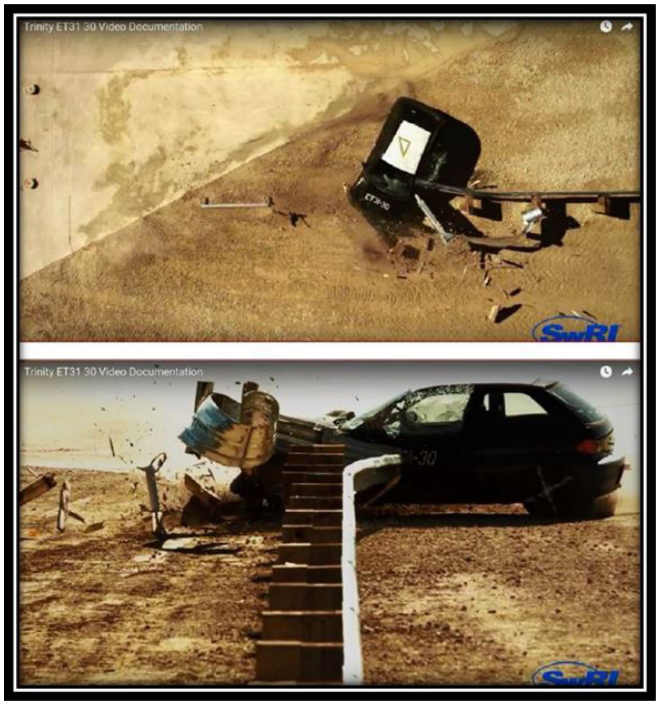
However, Trinity did not disclose these failures to the FHWA or any state transportation department.

JURY VERDICT FOR DEFRAUDING THE GOVERNMENT

On Oct. 20, 2014, a federal jury in Marshall, Texas, found Trinity Industries guilty of defrauding the U.S. government by intentionally misleading the FHWA about the design changes it made to the ET-Plus system.

But on Sept. 29, 2017, the 5th U.S. Circuit Court of Appeals reversed the record $663 million verdict and entered judgment in favor of Trinity. The court determined that Trinity's failure to disclose modifications to the ET-Plus did not constitute a "material" fraud on the government so as to support a False Claims Act claim.

Despite the qui tam ruling, the ET-Plus guardrail is still at the center of personal injury and wrongful-death lawsuits filed by crash victims and their families as it relates to the defective and dangerous nature of the end terminal.



FHWA DEMANDS ADDITIONAL CRASH TESTING

In late 2014, following the qui tam verdict, the FHWA required Trinity to conduct additional crash tests on the ET-Plus system.

During that test, the ET-Plus System buckled upon impact with the vehicle. As with the Flared ET-Plus crash tests, the buckling rotated the vehicle clockwise and slammed it into the blunt end of the exposed guardrail, causing extensive penetration into the driver's door. This failure was caused by the defects in the 4-inch ET-Plus extruder head.

At this time, more than half the country has banned the installation of the ET-Plus. ABC News featured our law firm and our work in representing people harmed by Trinity's ET-Plus. Accidents involving these products have been leaving victims maimed — and sometimes dead — from coast to coast.

THE LINDSAY X-LITE GUARDRAIL END TERMINALS

Defective guardrails have not been limited to Trinity. The X-Lite end terminal is a redirective, gating end terminal. It is made by Barrier Systems, which is a part of Lindsay Transportation Solutions Co. in California.

The X-Lite has a poor in-service performance record, and at least nine states have stopped using it. Some of these states have started replacing this model because of accidents that resulted in death and injuries.

In the wake of the Trinity lawsuits across the country and the finding of fraud, Lindsay designed, marketed and sold a new end rail concept. Whereas the ET-Plus and ET-2000 used the feeder chute system described above, the X-Lite was created so that the beams would slide and telescope upon each other and all come to a stop at the black and yellow end terminal. When impacted, the end rail often fails to properly contain the telescoping rails.

According to the FHWA, 29 states have the X-Lite installed on their roadways. There are about 14,000 X-Lite end terminals in the country, and more than three-fourths are found in states in the mid-Atlantic region.

In Lindsay's case, the "independent" testing that was conducted on the X-Lite was actually controlled by the manufacturer. The results of these tests determine whether federal funding will be provided to install these devices.

Trinity's woes with the ET-Plus opened an avenue for Lindsay to compete to install its products in states that were tearing the Trinity product out of the ground.

On June 15, 2017, Lindsay received FHWA support for the Lindsay MAX-Tension, a guardrail design that is similar to the X-Lite. It will be worth watching to see how the MAX-Tension performs if installed on America's highways.

CONCLUSION

As a result of ongoing litigation and public awareness, many states have barred the installation of these dangerous guardrail end terminals, and some have even begun the expensive process of removing them from the roadway. But nearly half the states continue to install these defective and dangerous guardrail systems on our roadways. Until they are removed, it is likely that more deaths and serious injuries will occur.

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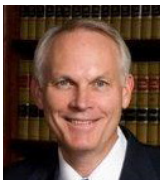
ABOUT THE AUTHORS



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